the case with other fish. The day after their birth they ate raw beef shred very small. These ten fish are now nearly six months old and are all females; the two old ones have each had young since; one had three alive and four dead, the other four alive and four dead; neither of these latter broods lived over a month and were unable up to the time of their death to rise from the bottom of the aquarium. Between the birth of each litter there was a period of about ten weeks. Those which are alive are all females and the succeeding litters were to all appearances males. It will be a curious circumstance, and a subject for future investigation, should every alternate litter prove to be of an opposite sex to the preceding one. No fish have yet been bred from those born in the aquarium and therefore it is not known at what age they begin to reproduce. C. FITZ GERALD. — *Lieut. H. M., 1st W. India Regt., Nassau, Bahamas, March 11th, 1864. — Communicated by the Smithsonian Institution.*

MICROSCOPY.

PHOTO-MECHANICAL PRINTING. — Incidentally to a pathological report to the Surgeon General, Dr. J. J. Woodward calls attention to the familiar disadvantages of the usual means of representing in publications the magnified appearance of microscopic objects by etchings, lithographs and woodcuts. All such hand work is laborious and wasteful of time if done by the investigator, and liable to omit the most important points if intrusted to another artist. Even the microscopist himself, being unable to represent all that he sees, is obliged to select what he conceives to be of importance, and thus represents his own theories rather than severe facts. [If, however, his theories are correct, and his delineation skilful, this very power of selection and construction enables him to give a distinctness and completeness which is lacked by the photographic camera.] The advantage of truthfulness is on the side of photo-micrography, but silver prints are expensive, inconvenient, and not permanent, and the reproduction of the negatives in permanent inks is greatly desired. Two such methods are now successfully used in the United States.

By the Woodbury method a relief surface of gelatine is produced from the negative by the action of light, and from this a metal "intaglio" is produced by pressure. In this a series of suitably colored gelatine films, which constitute the prints, are formed by

mechanical means. Thus was reproduced the photograph of *Amphipleura pellucida* in the last April number of this Journal.

In the Albertype process a printing surface (not a relief) is produced through the negative on a gelatine film by the action of light. The prints thus produced are, at present, less expensive than the Woodbury prints, and more convenient for book work, but the edition is less uniform. On enamelled paper the prints are handsomer, but will not bear much handling.

LENSES DRY OR IMMERSION. — Dr. Thomas Birt writes to the "Monthly Microscopical Journal" an enthusiastic notice of a "new" $\frac{1}{5}$th by Ross, arranged to work wet or dry by screw collar adjustment and without change of front, a peculiarity shared only, as far as he (Dr. Birt) was informed, by Powell and Lealand's $\frac{1}{8}$th. If the Ross $\frac{1}{5}$th is like some other recent lenses by the same house, it would be difficult to say too much for its excellence as an objective: the one thing that could not be said of it is that it has any possible claim to priority in respect to the peculiarity mentioned.

This expedient, like that of double fronts, is undoubtedly an American innovation. Objectives with double fronts and with double backs were made by Tolles and by Wales years ago, and were taken to London and exhibited there in advance of any knowledge of such a contrivance there. Lenses to work either wet or dry, by cover adjustment only, have been so generally made and familiarly used in this country as to be not now looked upon as an innovation at all. The question of priority is possibly a difficult one, but both Wales and Tolles made and sold them freely, long before any claim to any such arrangement was made by any foreign maker. Wales, as early as August 1867, made two objectives of this kind, to work both wet and dry with the same front, and they were exhibited at the Fair of the American Institute in New York, and received a first premium medal and diploma bearing date of October 1867; he was advised to patent the improvement at the time, but did better than that, and certainly ought to be favorably remembered for having given it to us for nothing. Tolles also constructed these objectives about the same time, having made such an objective and delivered it to a purchaser as early as June 29th, 1868, and the objective of the above date is still in existence, and is considered one of the best that have yet been constructed on that plan by its maker.

ANGULAR APERTURE OF OBJECTIVES. — In communications which have appeared in the NATURALIST and in the "Monthly Microscopical Journal" of London, different writers have treated of the improvements made in the construction of apparatus, and especially of objectives, and have chosen their own method of expressing their ideas, and of commenting upon the expressed opinions of others; but where the end aimed at is truth, and the result sought for is an advance in the quality of appliances, minor matters and side issues in the controversies are to be overlooked.

All lovers of progress in scientific research feel much pleased with the labors of investigators who make good use of the extensive means at their control, as well as also with the results which have emanated from the patient thought and close study of such men as Mr. Wenham and others abroad. We are very apt, however, to give too little credit to the intelligent instrument maker himself. The mind which combines science with practice in its application has great advantages and should be both respected and encouraged.

How we have been forced to modify our opinions, since an angle of aperture of, say, 150° in microscopical objectives was considered absolutely unattainable! No doubt the very men who honestly and firmly believed those things impossible which are now quite familiar, were as glad as any one, when they became convinced, by facts, that they had been in error.

Equally gratified, probably, will be Mr. Wenham, when he shall see for himself that an angle of more than 82° can be attained through balsam. Within a few days, I have had a good opportunity to see a $\frac{1}{10}$th objective of Mr. Tolles' make give an angle of 92° through balsam with tank arrangement of Mr. Wenham. I feel disposed, however, to let Mr. Tolles speak of this in his own words, the more so as my time is extremely limited. — J. C.

DR. JOSIAH CURTIS, *Dear Sir*:—At my request, you were present recently when I measured the angular aperture of an immersion 1-10 in. objective when immersed in balsam. You verified the results gained at that time. We used the tank method of Mr. Wenham (see M. M. Journal, August, 1871).

The 1-10 in. tested, I stated to you, had in air angular ap. of 170° (upwards).

In water we found the angle to be 110°+.

In balsam the angle was fairly 95°, using petroleum lamp flame, thin, for light, in a darkened room. As you will remember I remarked that with sunlight I got two degrees more.

It will, I know, be of interest to you, and I am sure to some others, to hear of results of test of angle in some other cases. I will, therefore, set down here the angle of aper-

ture found to pertain to some of my immersion objectives in balsam, in water and in air.

	Air.	*Air.*	*Water.*	*Balsam.*
Single Front.	1-18 in.	170°	120°	87°
" "	1-18 in.	170°	110°	88°
Compound Front.	1-10 in.	175°	117°	95°
" "	1-13 in.	175°	105°	
" "	1-6 (high)	172°	106°	88°
Single "	1-5 in.	175°	127°	110°

The varying differences between the water and balsam angles can, in a general way, be accounted for from the formulas of construction differing considerably, each one from any other.

Of all these objectives the most effective (especially when its low power is considered) is the 1-5 in. of 110° *in balsam.* This is true of its use for objects mounted in balsam, as Rhomboides, *small.* But notably so as to its work on dry A. pellucida. My London specimen of this, received through the U. S. A. Medical Museum, is resolved into lines that *shine,* I may say. The illumination I used was petroleum lamp flame, no condensation. With the same means *all* the objectives show A. pellucida with the same illumination, but with a difference.

With sunlight and a blue cell no doubt the higher powers would have their proper advantage.

It is proper to mention that the 1-5 in. of 110° balsam angle was constructed on the plan proposed by me in the Lon. "Month. Micr. Jour." for March 1872, where I have made use of a diagram by Mr. Wenham of a 1-8 in. of his construction, to *indicate* modifications such as would give more than 81° or 82° in balsam.

With proper appliances below the balsam-slide (as pointed out by me in the Lon. Month. Micr. Jour., for July, 1871) we can with this objective (1-5 in.) utilize 110°, instead of about 81°, the limit of the amount of angle otherwise available. *In the first place* the large angle must have access to and through the balsamed object *from below;* in the next place the objective must be capable of receiving and transmitting that dimension of pencil to the eye, which thing previous to my own demonstrations has not been shown to have been done.

With much respect, yours truly,

BOSTON, July 8, 1872. ROBERT B. TOLLES.

ORGANISMS IN CROTON WATER. — Chas. F. Gissler's pamphlet on this subject can be obtained of the Naturalists' Agency, though not so stated on the title page. While microscopists generally are now approaching this question of water supply from a utilitarian direction, seeking hints of healthfulness or pestilence in the organisms they detect, the author looks upon the Croton with inquisitive eyes, deeming the water New Yorkers drink a charming field for chasing rotifers and crustaceans, water-bears and worms, and scarcely giving a thought to their dietetic value. As far as can be gathered, he judges them healthy enough, with some comparatively unimportant exceptions. The pamphlet contains some very attractive plates, which are well calculated to accomplish the author's avowed object, giving encouragement and popularity to this branch of microscopical study.

DISTRIBUTION AND ACTION OF NERVES. — Dr. L. S. Beale and Dr. E. Klein have contributed valuable papers on this subject to

the Royal Microscopical Society and to the Memoirs in the Quart. Journ. of Microscopical Science. Interesting incidental discussions may be found in the Proceedings of the Royal Microscopical Society in recent numbers of the Monthly Microscopical Journal.

Dr. Beale, in reporting his progress on this subject, offers no methods of investigation, different from those already published, but hopes for improvement in practical details, and consequently in results. He has demonstrated the distribution of nerve fibres to capillaries in nearly all the tissues of the frog, and is convinced of their similar arrangement in the higher animals. These delicate nerve fibres are seen to branch directly from the dark-bordered nerve fibres, and are often so close to the capillary as to be seen distinctly only when the vessel shrinks after death; and they may often run along on each side of the vessel, or form a plexus upon its surface. They may originate from ganglia or from sensitive and motor nerve trunks, and have intimate relations to some of the nerves of special sense, and to nerve fibres distributed to the voluntary muscles. They never, according to the author's observations, come into structural relation with the active elements of other tissues, notwithstanding the growing belief that they do so; and their influence is not dependent upon continuity of substance. The author is quite certain that muscular contraction may depend upon changes in a nerve running near the muscular fibre but distinctly separated from it. A nerve fibre often passes for some distance by the side of a cell and then is lost to view by passing behind it, or is hidden by a pigment cell, leading to the conclusion that the nerve fibre has become continuous with the substance of the cell. Such errors can be avoided only by studying extremely delicate specimens in a viscid fluid in which their position can be changed; hence the author's preference for glycerine as a medium for these investigations. A fine nerve fibre less than $\frac{1}{10000}$ of an inch in diameter may often be traced for a long distance, its edges being well defined, and nuclei occurring at certain intervals. These fibres, demonstrated by Dr. Beale ten years ago when their existence was not admitted, are believed by him to constitute the ultimate or terminal nerve networks or plexuses. He admits that these are sometimes, and probably always, compound fibres, but does not admit the existence of another plexus of far finer fibres as claimed by some other observers, preferring to discuss the bearing of what he has been able to

demonstrate in a variety of cases, rather than to reason upon the observations of others.

Dr. Klein, on the other hand, by modifying the common method of staining by chloride of gold, brings the finest nerve fibres into view so clearly that they can be easily studied with powers as low as 250 to 300. The cornea of a rabbit or guinea pig is very slightly stained with chloride of gold; and sections cut, with a razor, are examined in glycerine. Oblique and horizontal sections are examined, and the binocular microscope exhibits easily the relation of the different plexuses to each other. Only the nerve fibres are colored, but the cells of the epithelium are distinctly seen. Dr. Klein confidently claims to demonstrate non-nucleated nerve fibres far finer than the ultimate plexus of Dr. Beale. The latter observer admits that his ultimate fibres are compound and that the nuclei are somewhat to one side of the main fibre. Dr. Klein looks upon all nucleated nerve fibres as sheathed, the nuclei belonging to the sheath, and finds no nuclei in the finer and simpler fibres. By the carmine and glycerine method no more has been demonstrated than the plexus of nucleated non-medullate nerve fibres; but with the gold method the existence of non-nucleated nerve fibres among the epithelial cells is shown with certainty. The anatomical continuity of these with the larger nerve trunks can be positively seen.

Dr. Berkart agreed with Dr. Beale in throwing some doubt on the supposed influence of the nervous system on nutrition. Atrophy of the muscles, for instance, might be due directly to causes operating directly on the muscular tissue, though generally ascribed, at present, to the influence of the nerves. The influence of the nerves on secretion was, however, well established in many cases.

Dr. Murie regarded Dr. Beale's paper a rare and valuable contribution to microscopic anatomy. In the *rete mirabile* of the porpoise, we have vessels of considerable size supplied with nerves ramifying in a manner similar to those demonstrated on the capillaries by Dr. Beale in his minute dissections. The electrical organ of the torpedo has an arrangement of nerves, visible to the naked eye, much like that described as occurring in the mole's nose. If there was, in the remarkable fish referred to, "a vast electrical battery supplied by nervous influence of gigantic power, was it not very probable that the same kind of thing obtained in the arterial capillaries, modified of course to the limited exigencies

of their contractile powers?" He inclined to agree with Dr. Beale that nerves did not enter those epithelial tissues where the epithelium is continuously thrown off, as they would then be unfavorably exposed.

Mr. Stewart had examined Dr. Klein's specimens and was convinced of the "existence of a fine plexus of nerves between the cells of the conjunctival epithelium, directly continuous with the coarser plexus of nerves situated in the middle layer of the cornea." In reference to the close analogy between nerve force and electricity, and the influence of the former on the circulation, he instanced the fact that if an electric current be passed through a capillary tube filled with water, the water will flow out: electric currents also influenced the passage of fluids through dialyzing membranes.

Dr. Lawson thought that our views of microscopical anatomy had been very much advanced by Dr. Beale's paper. In experimenting on the effect of certain substances on the capillary circulation of the frog, he had always reached the results shown by Dr. Beale — "that the effect on the blood vessels was due entirely to the action of the nerves, and not to the influence of the substance employed in the experiment."

Mr. Hogg valued Dr. Beale's treatment of the nerves of the capillaries, because microscopists had not hitherto been able to discover any contractile power in the walls of the capillaries nor to settle the question of the cause of the circulation through the capillaries. Dr. Beale believed that the nerves acted rather on the muscular fibres than on the walls of the capillaries. He should think, however, that the action was directly upon the capillary vessels. In the cornea the nerves probably exist for the purpose of preventing the entrance of blood into its structure.

Dr. Leared thought Dr. Beale's views would throw some light on the question of sleep, and the action of such drugs as bromide of potassium, which probably exert their power by controlling the cerebral circulation.

Dr. Beale explained, and stated his adherence to, his former statement of doubt, whether the nerves acted directly on the capillaries or the elementary cells of secreting glands. He was also positive that the statement that the nuclei always belong to the sheath was a mistake, as in many of his specimens nuclei could be demonstrated in hosts of fine nerves, which came off from non-

medullated fibres. He claimed priority of discovery in many cases, where it had been awarded by Dr. Klein to the German histologists. Many details of structure were given in his elaborate drawings, which are not explained at length in the text, for English readers will not read long and minute descriptions of such things.

Crystalline Forms in Glass. — The beautiful fern-like clusters of acicular crystals which are liable to form in a vitreous mass slowly cooling, have been described by the "Monthly Microscopical Journal" and by "Science Gossip" as produced artificially in blowpipe beads and in porphyrine, and as occurring naturally in pitchstone. Such a crystallization often takes place as an accident in a mass of slowly cooling glass, as when, at glass works, the melted contents of a retort become accidentally ruined and they are allowed to cool and be thrown away. The crystals produced under such circumstances are generally confused and merely form opaque masses or layers in the brilliant glass; but sometimes, as in a beautiful mass kindly furnished to the writer by Mr. Harding of the glass works at Berkshire, Mass., the crystalline clusters form distinct stars or rosettes imbedded in perfectly clear glass and looking wonderfully like what almost every microscopist has wished he could make — snow-flakes perfectly and permanently preserved. The beauty of these objects is realized only when they are examined on a black field and by the binocular, and preferably by reflected light.

The Leucocytes. — Dr. J. G. Richardson's report to the American Medical Association, "On the Structure of the White Blood Corpuscles," was essentially a reassertion of the previously published doctrine of the identity of the white corpuscles of blood, pus and saliva. He is satisfied that they all act essentially alike in saline solutions, and that the salivary corpuscles are not only like white blood corpuscles distended by endosmosis when immersed in a fluid less dense than serum, but that they may, when acted upon by a dense saline solution, contract to the size of the white blood corpuscle and exhibit like amæboid movements. He also strongly insists upon the presence of a cell-wall, a question which loses much of its definiteness as well as its importance in view of the fact that the discussions of Dr. Beale have led many if not most investigators to the belief that the cell-wall, in general, is only an accident of age and circumstance, rather than an indispensable and

primary element of structure, from which we deduce that its presence may often be a question of degree rather than a question of absolute fact.

As water distends, and finally ruptures and destroys, the white blood corpuscles, it is suggested that in surgical operations, much less harm would be done to the living tissues by washing or sponging them with, instead of water, a solution of about fifty-five grains of salt to the pint of water.

Spontaneous Generation. — Dr. J. C. Dalton's very able lectures reviewing this subject, close with the reflection that now, as always, the idea of spontaneous generation is confined to those organisms of which we know least; obscurity commencing where our definite knowledge fails. Although such production would naturally exist, if at all, among the smallest and simplest organisms, still the imperfect organization of these minute forms may be only apparent, and there is every evidence that at least their regular and normal mode of production is from germs disseminated in the atmosphere. Hence they are to be regarded as cryptogamic vegetable organizations, with a definite place in the organic world.

NOTES.

At a meeting of the California Academy of Sciences, held June 5th, Mons. Octave Pavy, the Arctic explorer, was introduced by Dr. Stout, who also presented the letter of the American Geographical Society of New York, introducing and warmly commending the gentleman. Professor Davidson hoped to hear M. Pavy's views concerning the geography of the Polar regions. He announced that a great current, not marked on any of the charts, had been discovered off the northwest coast of the continent, and that only the present week he had received from Alaska complete confirmation of the discovery.

M. Pavy then addressed the Academy upon his projected expedition. He said he had no doubt of the existence of an Arctic passage from the Pacific to the Atlantic — though one that was of course impracticable for purposes of commerce. The speaker referred to the various expeditions from time to time sent out to explore the Polar regions. He said that since that of Sir John Ross, the routes of the expeditions had all been from the east of the American Continent. He (Pavy) was about to enter by a